

Book: Marine Bioacoustic Signal Processing and Analysis

David K. Mellinger

Cooperative Institute for Marine Resources Studies

Oregon State University

2030 SE Marine Science Dr.

Newport, OR 97365 USA

phone: (541) 867-0372 fax: (541) 867-3907 email: David.Mellinger@oregonstate.edu

Award Number: N00014-07-1-1011

LONG-TERM GOALS

As the number of researchers and students entering the field of marine bioacoustics has grown, the types of signal processing, measurement, and analysis have undergone a parallel increase in sophistication. Acoustic signal processing has long been the domain of electrical and mechanical engineers, physicists, and mathematicians. However, more and more biologists and psychologists are starting to use advanced signal processing techniques and analyses, especially with the influx of the many signal processing programs now available. What is lacking for many of these new users is an understanding of the theoretical underpinnings of different techniques. This has happened because the learning curve can be rather steep, especially for those in the biological and psychological sciences, and the theoretical constructs are often ignored or deemed to difficult to comprehend. This also applies to many students and beginning researchers with a physical science background, since various ideas and methodologies are scattered across different texts and manuscripts.

Dr. Whitlow Au, of the University of Hawaii, and I are writing a book on animal bioacoustics that brings together ideas, concepts and methods that are often found in diverse texts and manuscripts. [Dr. Au has a separate ONR grant and is not a co-PI on this one.] We are approaching basic principles from the perspective of processing and analyzing acoustic signals emitted by animals. The book is aimed at advanced undergraduates and beginning graduate students – people with some background in sound analysis who come from a background in either an animal communication or signal processing. Our goal is to make a practical guide by which people can understand and use the tools we have, rather than an theoretical exposition of the frontiers of our field. Such a book, written with animal bioacousticians in mind, is strongly needed in order for the field to grow in fruitful directions.

OBJECTIVES

The objective is to write a technical book on signal processing for bioacoustics, with particular emphasis on the issues faced by marine bioacousticians.

APPROACH

We (Dr. Au and I) are currently working on writing the book. The table of contents for the book has changed a bit, and is now as follows:

Report Documentation Page			Form Approved OMB No. 0704-0188	
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>				
1. REPORT DATE 30 SEP 2011	2. REPORT TYPE	3. DATES COVERED 00-00-2011 to 00-00-2011		
4. TITLE AND SUBTITLE Book: Marine Bioacoustic Signal Processing and Analysis			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Oregon State University, Cooperative Institute for Marine Resources Studies, 2030 SE Marine Science Drive, Hatfield, OR, 97365			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	19a. NAME OF RESPONSIBLE PERSON	

1. Introduction
2. Introduction to digital signals
3. The Fourier transform
4. Time/frequency representations
5. Filtering
6. Equalization and normalization
7. Measurement and feature extraction
8. Localization
9. Tracking
10. Beamforming
11. Automatic call recognition
12. Call comparison
13. Call synthesis

Appendix: Recording techniques and equipment

Bibliography

Index

WORK COMPLETED

The text and graphics for Chapters 1-5 is completed, and Chapters 6-11 are in progress. We also have a publisher for the book, Springer-Verlag in New York, and an editor, Jace Harker.

Progress has been slower on these later chapters than it should be, since the project must be finished by Dec. 31. I have started setting aside 2 hours of uninterrupted per workday to work on the remaining chapters.

RESULTS

This project does not really have technical results, as it comprises writing a book.

IMPACT/APPLICATIONS

It is hoped that this book, when published, will help educate a generation of marine bioacoustics researchers about methods for analysis of marine acoustic signals. The existence of a basic text such as this will allow graduate students and advanced undergraduates to learn the fundamentals of bioacoustic signal processing.

RELATED PROJECTS

Whitlow Au has a companion project, with the same name, to co-write this book with me.

Also, Whitlow Au and Mardi Hastings have written an introductory book on bioacoustics. This book was published by Springer-Verlag at the end of 2008.